# UNITED STATES PATENT AND TRADEMARK OFFICE

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/761,217 | 01/16/2001 | Shailender Chaudlhry | SUN-P3900-SPL | 4812 |

| 22835 | 7590 | 12/28/2004 |
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|---|
| LI, AIMEE J |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2183 | |

DATE MAILED: 12/28/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on <u>12 October 2004</u>.

2a)☒ This action is **FINAL**.        2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) <u>1,3-9,12,14-20 and 23</u> is/are pending in the application.

   4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1, 3-9, 12, 14-20 and 23</u> is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

   Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

   Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   a)☐ All   b)☐ Some * c)☐ None of:

   1.☐ Certified copies of the priority documents have been received.

   2.☐ Certified copies of the priority documents have been received in Application No. _____.

   3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
   application from the International Bureau (PCT Rule 17.2(a)).

   * See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
   Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
   Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

U.S. Patent and Trademark Office

PTOL-326 (Rev. 1-04)                    Office Action Summary                    Part of Paper No./Mail Date 20041220.

## DETAILED ACTION

1.      Claims 1, 3-9, 12, 14-20 and 23 have been examined. Claims 1, 12, and 23 have been

amended as per Applicant's request. Claims 2, 13, and 24 have been cancelled as per

Applicant's request.

### *Papers Submitted*

2.      It is hereby acknowledged that the following papers have been received and placed on

record in the file: Amendment as received on 12 October 2004.

### *Claim Rejections - 35 USC § 102*

3.      The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the

basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4.      Claims 1, 3-9, 12, 14-20 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated

by Marcuello et al., *Value Prediction for Speculative Multithreaded Architectures* (hereinafter

Marcuello(1)), and further by Marcuello et al., *Speculative Multithreaded Processors*

(hereinafter Marcuello(2)), incorporated by reference in Section 2 of Marcuello(1).

5.      Regarding claims 1, 12 and 23, taking claim 12 as exemplary, Marcuello has taught an

apparatus that facilitates predicting a result produced by a section of code in order to support

speculative program execution, the section of code including a plurality of program instructions

(see Marcuello(2) Col.1 lines 11-16 and Col.2 line 47 – Col.3 line 9), the apparatus comprising:

a.     A head thread that is configured to execute the section of code within a program, wherein executing the section of code produces the result (see Marcuello(2) Col.5 lines 19-25),

b.     A prediction mechanism that is configured to generate a predicted result to be used in place of the result before the head thread produces the result (see Marcuello(2) Col.3 lines 2-9),

c.     A speculative thread that is configured to speculatively execute subsequent code within the program using the predicted result (see Marcuello(2) Col.3 lines 2-9 and Col.6 lines 14-20), wherein the subsequent code follows the section of code in an execution stream of the program (see Marcuello(2) Col.5 lines 26-29),

d.     A determination mechanism that is configured to determine if a difference between the predicted result and the result generated by the head thread affected execution of the speculative thread (see Marcuello(2) Col.4 lines 53-57 and Col.7 line 16 – Col.8 line16). Here, the NW field is updated, and subsequently checked, on every write operation to see if it has reached a value of zero, which happens when the difference between the predicted result and the head thread's result affected the speculative thread (see Marcuello(2) Col.7 line 48 – Col.8 line6).

e.     A joining mechanism that is configured to merge state associated with the speculative thread with state associated with the head thread if the difference did not affect execution of the speculative thread (see Marcuello(2) Col.4 line 53 – Col.5 line 5 and Col.5 lines 26-35),

g.      Wherein if the difference affected execution of the speculative thread, the

apparatus is configured to perform a rollback operation for the speculative thread

to undo actions performed by the speculative thread (see Marcuello(2) Col.8 lines

7-11).

6.      Here, the Applicant has described the above as the problem of a memory element having

been read by the speculative result when it should have first been written by the head thread,

causing erroneous results, and consequently either rolling back the speculative thread so it can be

re-executed if there was a problem, or committing the thread if there was no problem (p.10 lines

3-23 of the specification).  Marcuello has taught the comparing of the results of the head thread

and the speculative thread, and either rolling back the speculative thread to be re-executed if the

results were not equal (see Marcuello(2) Col.8 lines 7-11), or committing the thread if the results

were the same (see Marcuello(2) Col.4 lines 53-57).  Thus, Marcuello is operating in the same

manner as the claim language has stated, in that if the speculative thread incorrectly reads the

result of a write operation, it would produce erroneous results that would be detected in the

thread comparison of Marcuello and consequently perform the proper action.

7.      Claims 1 and 23 are nearly identical to claim 12.  Claim 1 differs in its lack of an

apparatus to perform its method upon, but encompasses the same scope as claim 12.  Claim 23

differs in it claiming a computer-readable storage medium storing instructions that when

executed by a computer cause the computer to perform a method, which is taught by Marcuello

(see Marcuello(1) "ICache" of Fig.1), but the method encompasses the same scope as claim 12.

Therefore, claims 1 and 23 are rejected for the same reasons as claim 12.

8.      Regarding claims 3 and 14, taking claim 14 as exemplary, Marcuello has taught the

apparatus of claim 12, wherein the determination mechanism is configured to determine if the

speculative thread accessed the predicted result.  Here, the Applicant has described the above as

the problem of a memory element having been read by the speculative result when it should have

first been written by the head thread, causing erroneous results, and consequently either rolling

back the speculative thread so it can be re-executed if there was a problem, or committing the

thread if there was no problem (p.10 lines 3-23 of the specification).  Marcuello has taught the

comparing of the results of the head thread and the speculative thread, and either rolling back the

speculative thread to be re-executed if the results were not equal (see Marcuello(2) Col.8 lines 7-

11), or committing the thread if the results were the same (see Marcuello(2) Col.4 lines 53-57).

Thus, Marcuello is operating in the same manner as the claim language has stated, in that if the

speculative thread incorrectly reads the result of a write operation, it would produce erroneous

results that would be detected in the thread comparison of Marcuello and consequently perform

the proper action.

9.      Claim 3 is nearly identical to claim 14, differing in its parent claim, but encompassing the

same scope.  Therefore, claim 3 is rejected for the same reasons as claim 14.

10.     Regarding claims 4 and 15, taking claim 15 as exemplary, Marcuello has taught the

apparatus of claim 12, wherein the determination mechanism is configured to determine if the

predicted result differs from the result generated by the head thread (see Marcuello(2) Col.4 lines

53-57).

11.     Claim 4 is nearly identical to claim 15, differing in its parent claim, but encompassing the

same scope.  Therefore, claim 4 is rejected for the same reasons as claim 15.

12.     Regarding claims 5 and 16, taking claim 16 as exemplary, Marcuello has taught the

apparatus of claim 12, wherein the prediction mechanism is configured to generate the predicted

result by looking up a value based upon a program counter for the program (see Marcuello(1)

Col.7 lines 14-20).

13.     Claim 5 is nearly identical to claim 16, differing in its parent claim, but encompassing the

same scope. Therefore, claim 5 is rejected for the same reasons as claim 16.

14.     Regarding claims 6 and 17, taking claim 17 as exemplary, Marcuello has taught the

apparatus of claim 16, wherein the prediction mechanism is configured to generate the predicted

result by additionally looking up the value based upon at least one previously generated value for

the result (see Marcuello(1) Col.5 lines 22-38).

15.     Claim 6 is nearly identical to claim 17, differing in its parent claim, but encompassing the

same scope. Therefore, claim 6 is rejected for the same reasons as claim 17.

16.     Regarding claims 7 and 18, taking claim 18 as exemplary, Marcuello has taught the

apparatus of claim 16, wherein the prediction mechanism is configured to generate the predicted

result by performing a function on the value (see Marcuello(1) Col.5 lines 28-31).

17.     Claim 7 is nearly identical to claim 18, differing in its parent claim, but encompassing the

same scope. Therefore, claim 7 is rejected for the same reasons as claim 18.

18.     Regarding claims 8 and 19, taking claim 19 as exemplary, Marcuello has taught the

apparatus of claim 12, wherein the section of code includes one of a method, a function and a

procedure (see Marcuello(1) Col.3 lines 24-33).

19.     Claim 8 is nearly identical to claim 19, differing in its parent claim, but encompassing the

same scope. Therefore, claim 8 is rejected for the same reasons as claim 19.

20.     Regarding claims 9 and 20, taking claim 20 as exemplary, Marcuello has taught the

apparatus of claim 12, wherein the section of code is a body of a loop in the program, and the

result is a loop carried dependency for the loop (see Marcuello(1) Col.4 line 37 – Col.5 line 7).

21.     Claim 9 is nearly identical to claim 20, differing in its parent claim, but encompassing the

same scope.  Therefore, claim 9 is rejected for the same reasons as claim 20.

### *Response to Arguments*

22.     Applicant's arguments filed 12 October 2004 have been fully considered but they are not

persuasive.

23.     Applicant's argue in essence on pages 9-10

> ...Note that **rolling back a speculative thread implies that the speculative**
>
> **thread is not squashed**; instead, the speculative thread is rolled back to an earlier
>
> execution point.
>
> Note that the process of rolling back a speculative thread to undo any results
>
> generated by the speculative thread is not obvious because it involves the complex
>
> operations described on page 14, line 13 through page 17, line 21...Moreover,
>
> read bits are used to keep track of which fields within a data region have been
>
> read since the last rollback...

24.     This has not been found persuasive.  The claim states "a rollback operation for the

speculative thread to undo actions performed by the speculative thread."  Marcuello has taught a

rollback operation in regards to the claim language.  By squashing a thread Marcuello, in effect,

reverts the thread back to a state prior to executing the mispredicted speculative thread, since the

speculative instructions are never committed and do not change the thread to the current

execution point in the speculative thread. Rather, squashing stops commitment of the speculative thread, so the thread is in the earlier execution point prior to the speculative execution, effectively undoing all the speculative execution. Therefore, squashing the speculative thread is a type of rollback operation, since it essentially undoes actions performed by the speculative thread.

25.     In addition, the complex operations described on page 14, line 13 through page 17, lint 21 and the read bits are not claimed. The implication of the language cannot be read into the claims, as the arguments seem to allude to. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the complex operations and read bits) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

## *Conclusion*

26.     **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

27.     A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,
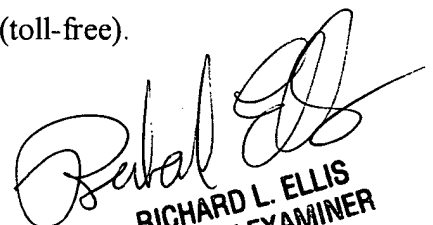
however, will the statutory period for reply expire later than SIX MONTHS from the mailing

date of this final action.

28.     Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Aimee J Li whose telephone number is (571) 272-4169. The

examiner can normally be reached on M-T 7:30am-5:00pm.

29.     If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the

organization where this application or proceeding is assigned is 703-872-9306.

30.     Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR

system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AJL
Aimee J. Li
20 December 2004

RICHARD L. ELLIS
PRIMARY EXAMINER